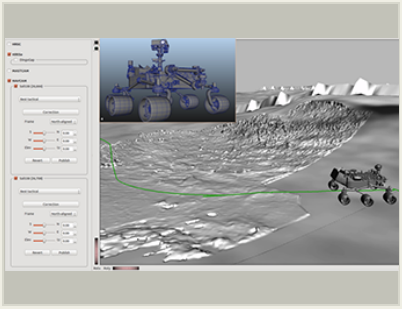
Unified Representation for Collaborative Visualization and Processing of Terrain Data, Phase I

Completed Technology Project (2017 - 2018)

Project Introduction

We build upon our prior work applying subdivision surfaces (subdivs) to planetary terrain mapping. Subdivs are an alternative, multi-resolution method with many advantages over conventional digital elevation maps (DEM's) and fixed-resolution meshes. The proposed research is innovative in presenting a new setting for subdivs demanding novel extensions to subdiv algorithms, techniques and theory as well as new methods in merging of terrain data from multiple sources. Our primary objectives are to: (1) develop a prototype mapping system using subdivs as a representation for terrain data with highly varied spatial resolution and 3-D features; (2) extend our novel volumetric merging method, integrating input data at varied confidence levels from varied source formats (DEM, point cloud, range data, etc.) while supporting overhanging and cave-like terrain geometry; (3) demonstrate collaborative use of registered surface detail with terrain-mapped data fields such as terrain color, confidence estimates, and science-data overlays; and (4) show, via high-quality DEM extraction, compatibility with existing systems including applicability for autonomous processing on small, weight- and power-constrained (SWAP) robots. The expected benefits are: (a) higher-fidelity terrain visualization with reduced processing error and lower infrastructure requirements; (b) ability to visualize 3-D features, such as overhangs, missed in DEM's; (c) compact encoding with natural level-of-detail control for interactive viewing on mobile devices; (d) greater algorithmic efficiency for non-visualization scientific computation; and (e) enablement of new software-tool capabilities for dynamic mapping of alternative local-terrain datasets, non-destructive experimentation, collaboration, and data traceability. The innovation also promises capability and reliability benefits to robots by unifying terrain representations and enabling minimal upload of only incremental terrain details from the ground.



Unified Representation for Collaborative Visualization and Processing of Terrain Data, Phase I Briefing Chart Image

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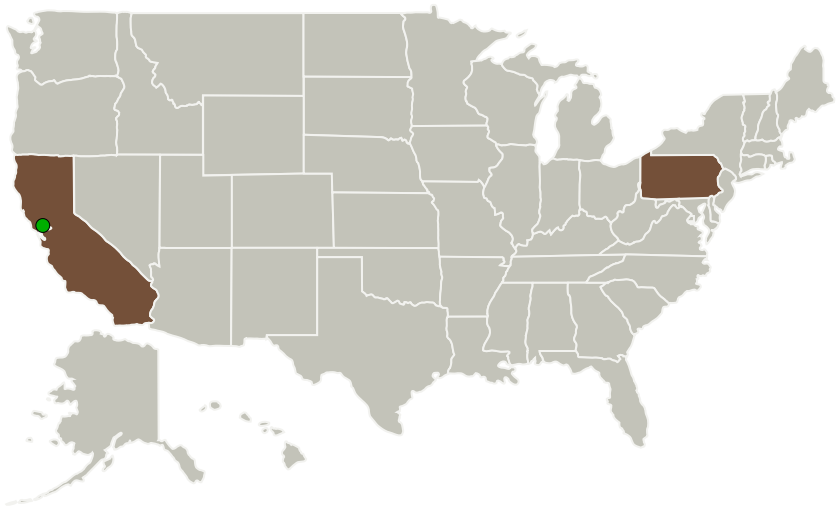
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
DigitalFish, Inc.	Lead Organization	Industry	San Mateo, California
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
Carnegie Mellon University	Supporting Organization	Academia	Pittsburgh, Pennsylvania

Primary U.S. Work Locations	
California	Pennsylvania

Project Transitions

June 2017: Project Start

June 2018: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140853)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

DigitalFish, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

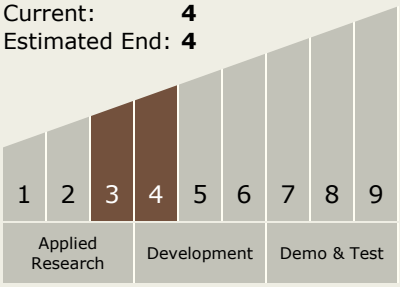
Carlos Torrez

Principal Investigator:

Daniel L Herman

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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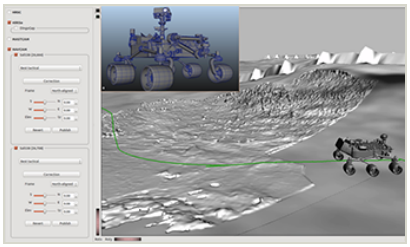
Images



Briefing Chart Image
Unified Representation for Collaborative Visualization and Processing of Terrain Data, Phase I Briefing Chart Image
(https://techport.nasa.gov/image/130631)

Technology Areas

Primary:

- TX04 Robotic Systems
  - TX04.4 Human-Robot Interaction
    - TX04.4.1 Multi-Modal and Proximate Interaction

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System